MR imaging findings of uterine endometrial stromal sarcoma: differentiation from endometrial carcinoma

Abstract Endometrial stromal sarcoma (ESS) is a rare malignant neoplasm of the uterus. We retrospectively analyzed pelvic MR imaging in 8 cases of ESS to determine the characteristic MR findings of ESS. Magnetic resonance images of 8 cases of ESS were evaluated for findings including the size, margin of the tumor, nodular lesions at the tumor margin, intramyometrial worm-like nodular extension, multiple nodular mass formation, hemorrhage, and necrosis in the tumor. The degree of contrast enhancement was also analyzed. The MR imaging findings of 21 consecutive cases of endometrial carcinoma (EC) were also evaluated and compared with those of ESS. The mean and the standard deviation of the maximum diameter of ESS and EC were $8.80 \pm 4.99$ and $3.93 \pm 2.47$ cm, respectively. Increased enhancement in at least a part of the tumor was observed in five of the six analyzed ESS cases and in 2 of 12 analyzed EC cases. The irregular margin, nodular lesions at the margin, intramyometrial nodular extension, and multiple nodular mass formation were more frequently seen in cases of ESS than in cases of EC. Magnetic resonance imaging can play a role in both diagnosing ESS as well as in differentiating ESS from EC.

Key words MR imaging · Uterus · Endometrial stromal sarcoma · Endometrial carcinoma

Introduction

 Sarcomas, such as leiomyosarcoma, endometrial stromal sarcoma (ESS), mixed mullerian tumor (MMT), make up only 2–5% of uterine malignancies [1, 2], whereas ESS comprises less than 10% of all uterine sarcomas [1, 3]. Endometrial stromal tumors are defined as tumors that are composed of cells identical to or closely resembling normal proliferative-phase endometrial stromal cells [1, 2, 3]. Endometrial stromal tumors occur in two basic forms: one is a benign endometrial stromal nodule which is a circumscribed, expansile neoplasm, and the other is ESS which infiltrates the myometrium and also has metastatic potential. Endometrial stromal sarcoma ranges from a low-grade neoplasm to a high-grade sarcoma [1, 2, 3]. As many as half of low-grade ESS may appear well circumscribed, and many of the others are described as demonstrating diffuse myometrial permeation by worm-like masses or multiple nodules [1, 2]. High-grade ESS infiltrates the myometrium in a more destructive manner and is associated with areas of hemorrhage and necrosis, unlike low-grade ESS [1, 2]. High-grade ESS may take the form of a single polypoid or grossly infiltrative mass, multiple
confluent nodules, or tumors that diffusely infiltrate the myometrium. The mean age of women with ESS ranges from 42 to 53 years [1]. Cases of stage-I low-grade ESS have a greater than 80% 5-year survival rate, in contrast to approximately 50% for the 5-year survival rates reported for stage-I high-grade ESS [1]. The 5-year survival rate of stage-I endometrial carcinoma (EC) ranges from 82 to 95% [1, 3]. Because of these prognostic differences, the preoperative diagnosis and grading are meaningful. Magnetic resonance imaging has been reported to be an effective modality for representing the macroscopic appearance of uterine tumors. We report the MR imaging findings of 8 histologically proven cases of ESS compared with 21 cases of EC. None of the cases were diagnosed correctly prior to surgery. Although the number of cases is small, to the best of our knowledge there has been only one report of 8 cases [4] and some case reports of ESS studied by MR imaging [5, 6, 7] in the literature, and also this is the first report differentiating ESS from EC.

Materials and methods

Eight women, ranging from 35–66 years of age (mean age 51.5 years), with pathologically proven ESS were included in this retrospective study. Four cases were diagnosed to have low-grade ESS and the other four cases were diagnosed to have high-grade ESS pathologically. The pretreatment MR studies of these cases were collected from multiple institutions. Two cases whose tumors were located in the myometrium (cases 3 and 7) have been previously presented as a case report [8]. In 5 cases the tumors were located in the endometrium, four of them infiltrated the myometrium, and one small tumor (case 1) was localized in the endometrium. In 2 cases the tumors were located in the myometrium and one of them was completely separate from the endometrium [8]. In 1 case the tumor was located in the cervix and invaded the vagina. Six patients suffered from vaginal bleeding (cases 1, 2, 3, 5, 6, and 8), one had lower abdominal pain (case 4), and the other one had back pain (case 7).

For comparison, MR studies of the pelvis in 21 consecutive cases of proven EC were retrospectively collected from one of the institutions. The cases of EC included 8 stage-Ia cases, 11 stage-Ib cases, 1 stage-IIa case, and 1 stage-IIc case. Their ages were 37–86 years (mean age 63.1 years).

Magnetic resonance images were generated with SMT-100 (Shimadzu, Kyoto, Japan) using a 1.0-T superconductive magnet (cases 1, 4, 5, 6, and 8), Magnetom Vision (Siemens, Erlangen, Germany) using a 1.5-T superconductive magnet (case 2), Signa Advantage (General Electric, Milwaukee, WI) using a 1.5-T superconductive magnet (case 7), and Siemens (General Electric-Yokogawa, Tokyo, Japan) using a 1.5-T superconductive magnet (case 7). T1-weighted images and T2-weighted images were obtained in all cases. At SMT-100, Magnetom Vision, Signa Advantage, and Siemens, T1-weighted spin-echo (SE) images were applied with TR/TE = 500–600/15–25, 576/12.0, 600/10, and 500/18 ms, respectively, and T2-weighted SE or fast SE (FSE) images were applied with TR/TE = 2000/80–90 (SE), 3000/120 (FSE, echo train length (ETL) = 15), 300/102 (FSE, ETL = 8), and 2500/101 ms (FSE, ETL = 16), respectively. Contrast-enhanced T1-weighted SE images were obtained in 6 cases after intravenous administration of 0.1 mmol/kg of gadopentetate dimeglumine (Magnevist, Schering, Osaka, Japan).

In case 2 dynamic images were also obtained every 30 s from just after injection until 120 s thereafter. Ten-millimeter-thick contiguous sections were obtained in the sagittal and axial planes with SMT-100; 6-mm-thick sections with 3-mm gap were obtained in the sagittal plane and with 2-mm gap in the axial plane with Magnetom Vision. Six-millimeter-thick sections with 2-mm gap were obtained in the sagittal and axial planes with Signa Advantage: 4-mm-thick sections with 1-mm gap were obtained in the sagittal plane and 7-mm-thick sections with 2-mm gap were also obtained in the axial plane with Siemens.

Interpretation of the MR images was made combined with the knowledge of the pathologic diagnosis and surgical findings. Case 5, in which a tumor was located at the uterine cervix and invaded vagina, was thought to be inadequate and was thus excluded from the evaluation of the margin and intramural nodular extension.

The MR images were evaluated regarding such factors as the size of the tumor, signal intensities (SI) of solid part of the tumor on T1-weighted images, T2-weighted images, and contrast-enhanced T1-weighted images, the margin of the tumor, nodular lesions at the tumor margin, intramyometrial worm-like nodular extension, multiple nodule formation inside the tumor, hemorrhage, and necrosis in the tumor. The SI of the solid component of the tumors was evaluated by comparing them with those of the myometrium. Both findings of nodular lesions at the tumor margin and intramyometrial worm-like nodular extension were thought to represent invasive features of the tumor [1], and the former nodules were defined as those attached to the tumor margin and the latter nodules were defined as those detached from the tumor. Hemorrhage and necrosis were defined as the highest-intensity areas on T2-weighted images without contrast enhancement [11]. Hemorrhage showed hyperintensity and thus could be differentiated from necrosis which showed low intensity on T1-weighted images.

Statistical analysis was done by Student’s t-test to compare the tumor diameters and by Fisher’s exact probability test to compare all other MRI findings.

Results

The maximum diameter of the ESS tumors ranged from 1 to 19 cm, with a mean value of 8.8 cm. On T1-weighted images 3 cases showed high SI. On T2-weighted images all cases showed high SI. In 5 of 6 cases, including the cervical tumor in case 5, contrast enhancement was higher than that of the myometrium (Fig. 1b). The other tumor in case 2 demonstrated slightly increased SI in the dynamic study (Fig. 2b–d). In 5 of 7 cases, excluding the cervical tumor in case 5, the tumor margins were irregular and in 4 cases nodular lesions were found adjacent to the margin (Figs. 1, 2). In 3 of 7 cases, excluding the cervical tumor in case 5, intramyometrial worm-like nodular extension was seen with high SI on T2-weighted images (Figs. 1, 2). The intramyometrial nodular lesions could hardly be detected on T1-weighted images and the SI of the lesions did not increase as much as that of the myometrium on contrast-enhanced T1-weighted images (Figs. 1, 2). In cases 2 and 6, these nodular lesions were proved to represent intralymphatic or intravascular tumor nodules microscopically. In 6 cases the